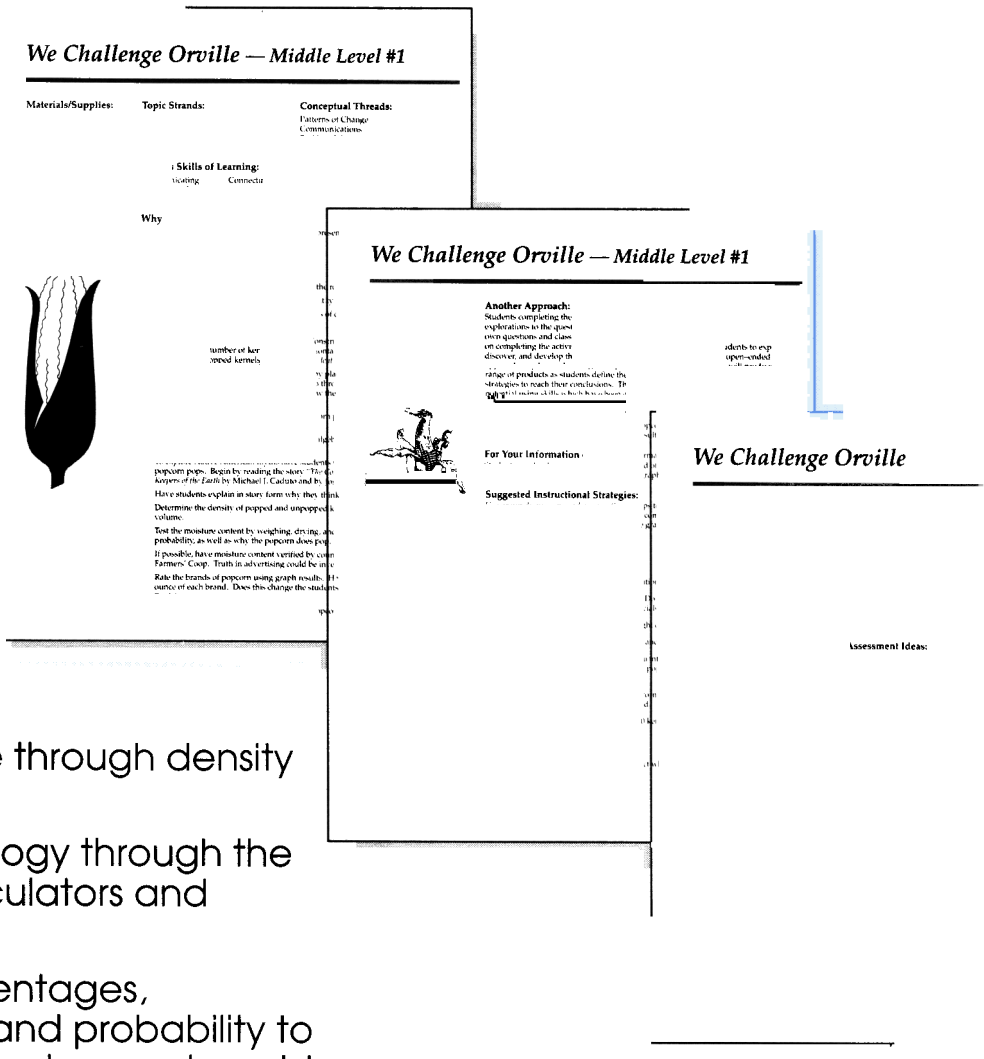
We Challenge Orville

"We Challenge Orville" is an example of one middle–level instructional model that was developed by practicing teachers to reflect the philosophy of the Nebraska Mathematics/Science Frameworks.

A reduced scale model is used on the inside pages to demonstrate how the Mathematics/Science Frameworks addresses the issues of multiculturalism, connections, inquiry/problem solving, and assessment by showcasing one instructional model.

Frameworks In The Classroom


We Challenge Orville — Middle Level #1

Materials/Supplies:

Topic Strands:

Conceptual Threads:
Patterns of Change
Communications

Skills of Learning:

Why

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Another Approach:

For Your Information:

Suggested Instructional Strategies:

We Challenge Orville

Assessment Ideas:

Connections:

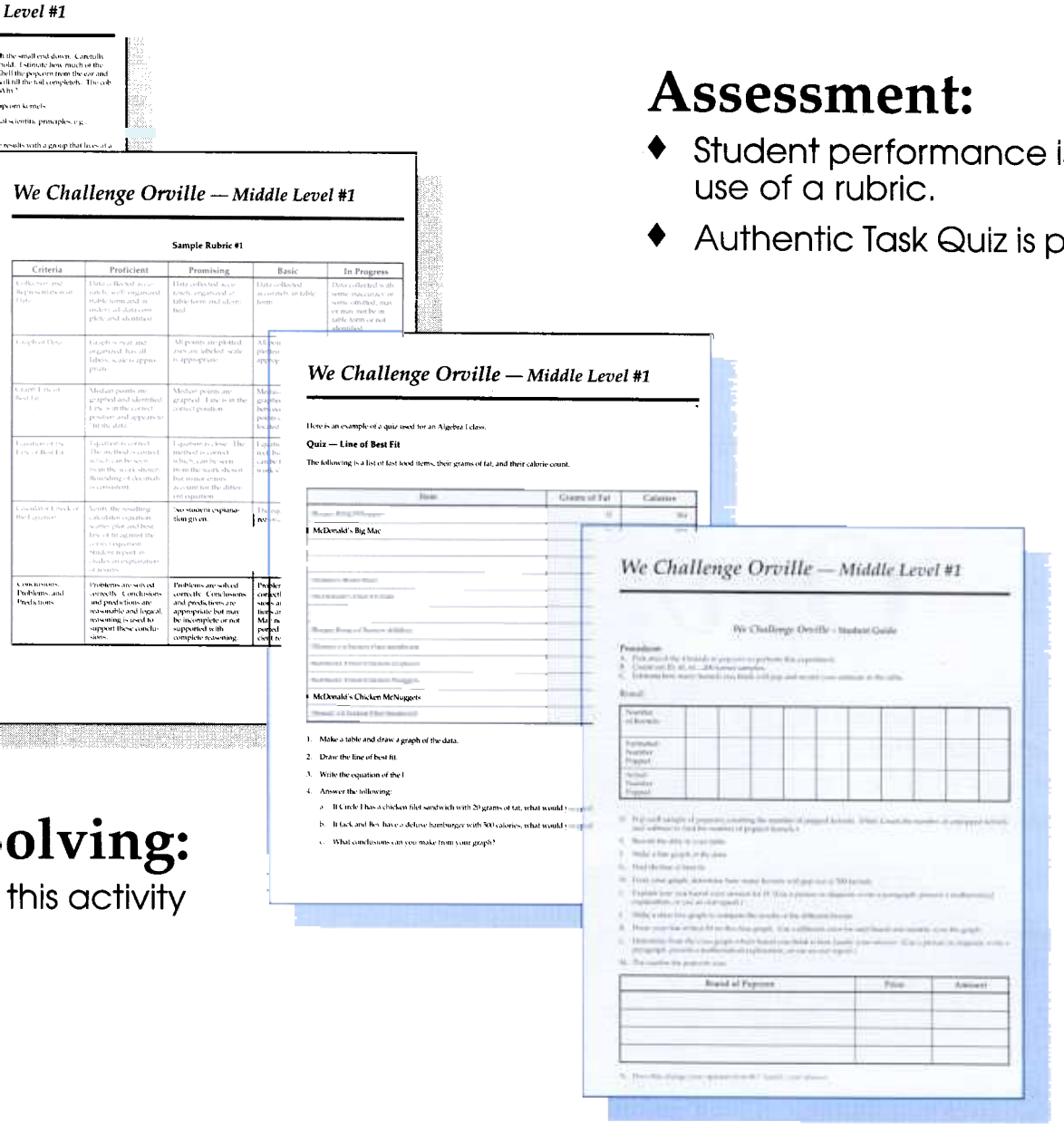
- Connects to science through density exploration.
- Connects to technology through the use of graphing calculators and popcorn poppers.
- Uses graphing, percentages, fractions, decimals, and probability to connect mathematics to a real–world event.
- Read and discuss *"The Coming of Corn"* in *Keepers of the Earth* by Michael J. Caduto and Joseph Bruchaic.
- A visit from a Farmers' Coop or a County Extension Agent provides a good community connection.
- Consumer awareness is promoted by product comparison.

Inquiry/Problem S

- Process skills emphasized i include:
  - communication,
  - interpretation of dat
  - predicting, and
  - reasoning (justifying

Multiculturalism:

- Group effort lowers individual student's anxiety.
- A variety of representations can be used to justify answers.
- Comparison of different brands promotes student interaction and sharing of ideas.
- Student research of Native American myths encourages different perspectives to be shared.



Assessment:

- Student performance is assessed by use of a rubric.
- Authentic Task Quiz is provided.

olving:

this activity

Students participating in "We Challenge Orville"

Four middle–level instructional models developed from student–centered activities follow. Teachers who have piloted the models have reported pleasantly increased interest and engagement from their students, as well as much higher levels of student questioning. In workshops, the instructional models tend to generate healthy discussions about the implications of national standards and state frameworks.

We Challenge Orville Middle Level #1

Materials\Supplies:
Several brands of popcorn, such as maize, field corn, commercial products
Popcorn poppers
Graphing calculators
Measuring cups
Bowls (clear and large to measure volume)
Paper bags
Coffee filters

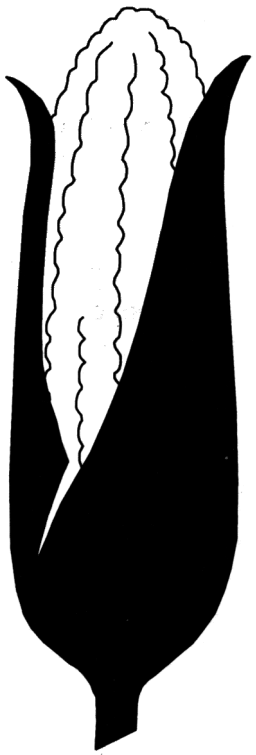
Topic Strands:
Matter
Number Sense
Data Analysis

Conceptual Threads:
Patterns of Change
Communications
Problem Solving

Process Skills of Learning:

Communicating	Connecting	Interpreting Data
Measuring	Observing	Predicting

Why (Purpose/Objective of the lesson):
To illustrate, by using popcorn, how numerical representations relate to quality control, the density of the kernels, and to moisture content.



How (Procedure of the lesson):

1. Display different types of corn at the front of the room.
2. Discuss by comparing and contrasting different types of corn.
3. Assign groups to pop one of the different types of corn.
4. Refer to student guide for procedure.
5. Use graph paper to make coordinate axes. Construct comparable graphs by graphing total number of kernels on the horizontal (*independent* or *manipulative* variable) and popped kernels vertically (*dependent* or *responding* variable).
6. Line of best fit. Lay ruler on its edge. Begin by placing left end of ruler at the ordered pair (0,0). Not all best fit lines will go through the point (0,0). Move ruler so that half of the points are above and half below the line. Lay the ruler down and draw the line of best fit.
7. Percentages-fractions-decimals — write popcorn popped as a percentage, fraction, or ratio.
8. Graphing calculators — have an upper-level algebra class demonstrate the use of a graphing calculator.
9. To explore Native American myths have students write their own legend of why popcorn pops. Begin by reading the story *"The Coming of Corn"* found in the book *Keepers of the Earth* by Michael J. Caduto and by Joseph Bruchac.
10. Have students explain in story form why they think popcorn pops.
11. Determine the density of popped and unpopped kernels. Graph the mass and volume.
12. Test the moisture content by weighing, drying, and weighing again; and compare to probability, as well as why the popcorn does pop.
13. If possible, have moisture content verified by county agent or representative of Farmers' Coop. Truth in advertising could be investigated.

We Challenge Orville Middle Level #1

14. Rate the brands of popcorn using graph results. Have students determine cost per ounce of each brand. Does this change the students' opinions of which brand is best? Explain.
15. Write advertisements to "sell" each group's popcorn brand.

Another Approach:
Students completing the structured activities described in #1–15 will limit their explorations to the questions asked by the teacher. They will probably not generate their own questions and class members will produce similar results. The students will focus on completing the activity. To reduce these limitations and allow students to explore, discover, and develop their own method to solve a problem, a more open-ended approach may be used. Using an inquiry/problem-solving strategy will produce a wide range of products as students define their problems differently and use different strategies to reach their conclusions. This method challenges the students to reach their potential using skills which have been developed in other activities.

A Student-Centered Approach:
Design an experiment to determine which popcorn is best. Students should experiment, collect and analyze data, and present their results to the class.

For Your Information (Background information for the lesson):
Students need to have access to the same kind of popcorn popper to make circumstances equal. Graphing calculators can be used to graph results.

Suggested Instructional Strategies:
Use group discussions and cooperative groups to problem solve and investigate. Teacher acts as facilitator and discussion leader. Use community resources such as extension agents, elevator operators, and farmers. Use graphing calculators or computer graphing programs.

Additional Activities (Extensions):
1. Use kernels to exhibit exponential estimation.
2. Make popcorn balls with mixing colors. Do cost analysis of making and selling popcorn/popcorn balls. Create commercials and record on video tape.
3. Investigate other properties of corn-weight changes, color, density, etc.
4. Compare commercial brands of popcorn and homegrown popcorn.

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5. Instead of counting kernels, measure a quantity (⅓ cup), count the kernels in the sample and compare volumes of popped popcorn as well as the number of unpopped popcorn.
6. Explore the temperature a kernel of popcorn will pop at or the effect of the type of popcorn popper (hot air, grease, etc.) used.
7. To compare quality and quantity, use 200 kernels of each brand. Repeat each trial to increase validity.
8. Rank the popcorn by taste.
9. Take the top off an air-popper and predict where and how far the popcorn will land.
10. Wrap tin foil tightly around an ear of popcorn with the small end down. Carefully slip the ear of popcorn out of the foil leaving the mold. Estimate how much of the mold will be filled when the popcorn is shelled. Shell the popcorn from the ear and return the kernels to the tinfoil cast. The kernels will fill the foil completely. The cob will be left over. It looks like matter was created. Why?
11. Investigate the effects of refrigeration or age on popcorn kernels.
12. The slope of the graphs can be used to show several scientific principles; e.g., velocity, acceleration.
13. Graph mass and volume. Use internet to compare results with a group that lives at a much different altitude.

Possible Assessment Ideas:

1. Student performance. Criteria is specified in sample rubric.
2. Student involvement in group sharing of ideas.
3. Authentic task quiz on fast foods to assess each student's ability to graph a best fit line is found on page L – 40.

We Challenge Orville Middle Level #1

Sample Rubric:

Criteria	Proficient	Promising	Basic	In Progress
Collection and Representation of Data	Data collected accurately, well-organized (table form and in order), all data complete and identified.	Data collected accurately, organized in table form, and identified.	Data collected accurately in table form.	Data collected with some inaccuracy or omissions, may or may not be in table form or identified.
Graph of Data	Graph is neat and organized, has all labels, scale is appropriate.	All points are plotted, axes are labeled, scale is appropriate.	All points are plotted, scale is appropriate.	Scale is not appropriate, not labeled, points plotted incorrectly or omitted.
Graph Line of Best Fit	Median points are graphed and identified. Line is in the correct position and appears to "fit the data."	Median points are graphed. Line is in the correct position.	Median points are graphed. Line is between the median points but located incorrectly.	Median points are graphed but may be incorrect. Line appears to not "fit" the data.
Equation of the Line of Best Fit	Equation is correct. The method is correct, which can be seen from the work shown. Rounding of decimals is consistent.	Equation is close. The method is correct, which cannot be seen from the work shown. Minor errors account for the incorrect equation.	Equation is incorrect, but the error can be found in the work shown.	There is an equation, but no work is shown so errors or method cannot be found.
Calculator Check of the Equation	Verifies the resulting calculator equation, scatter plot, and line of fit against the correct equation. Includes an explanation of results.	No student explanation given.	The equations are reasonably close.	Equation does not match.
Conclusions, Problems, and Predictions	Problems are solved correctly. Conclusions and predictions are reasonable and logical; reasoning is used to support these conclusions.	Problems are solved correctly. Conclusions and predictions are appropriate but may be incomplete or not supported with complete reasoning.	Problems are solved correctly. Conclusions and predictions are given. May not be supported with sufficient reasons.	Problems, conclusions, and predictions are given but may be incorrect, incomplete, or have no reason stated.

We Challenge Orville — Middle Level #1

Here is an example of a quiz used for an Algebra I class.

Authentic Task Quiz Line of Best Fit

The following is a list of fast food items, their grams of fat, and their calorie count.

Item	Grams of Fat	Calories
Burger King Whopper	33	584
McDonald's Big Mac	34	572
Wendy's Big Classic	28	500
Arby's Roast Beef	19	365
Hardee's Roast Beef	17	338
McDonald's Filet-O-Fish	23	415
Arby's Chicken Breast Sandwich	32	567
Burger King's Chicken Tenders	12	223
Hardee's Chicken Filet Sandwich	20	431
Kentucky Fried Chicken (2 piece)	31	460
Kentucky Fried Chicken Nuggets	17	281
McDonald's Chicken McNuggets	18	286
Wendy's Chicken Filet Sandwich	24	479

1 Make a table and draw a graph of the data.

2. Draw the line of best fit.

3. Write the equation of the line of best fit.

4. Answer the following:
   a. If Circle J has a chicken filet sandwich with 20 grams of fat, what would you predict its calorie count to be?

   b. If Jack and Bev have a deluxe hamburger with 500 calories, what would you predict the fat grams to be?

   c. What conclusions can you make from your graph?

We Challenge Orville Middle Level #1

WE CHALLENGE ORVILLE - Student Guide

Procedure:

A. Pick one of the 4 brands of popcorn to perform this experiment.
B. Count out 20, 40, 60,...200 kernel samples.
C. Estimate how many kernels you think will pop and record your estimate in the table.

Brand:

Number of Kernels										
Estimated Number Popped										
Actual Number Popped										

D. Pop each sample of popcorn, counting the number of popped kernels. (Hint: Count the number of unpopped kernels and subtract to find the number of popped kernels.)
E. Record the data in your table.
F. Make a scatter plot of the data.
G. Find the line of best fit.
H. From your graph, determine how many kernels will pop out of 500 kernels.
I. Explain how you found your answer for H. (Use a picture or diagram, write a paragraph, present a mathematical explanation, or use an oral report.)
J. Make a class line graph to compare the results of the different brands.
K. Draw your line of best fit on the class graph. Use a different color for each brand and identify it on the graph.
L. Determine from the class graph which brand you think is best. Justify your answer. (Use a picture or diagram, write a paragraph, present a mathematical explanation, or use an oral report.)
M. The cost for the popcorn was:

Brand of Popcorn	Price	Amount

N. Does this change your opinion from question L? Justify your answer.

Rocks and Rubberbands Middle Level #2

Materials\Supplies:
Sandwich bags with wide rubber bands attached
Sets of 10 similarly sized, washed rocks
Meter sticks
Graphing calculators

Topic Strands:
Force and Motion
Force and Motion
Algebraic Topics

Conceptual Threads:
Energy
Patterns of Change
Connections

Process Skills of Learning:
Inferring Interpreting Data Measuring
Modeling Predicting

Why (Purpose/Objective of the lesson):
To observe properties of energy and elasticity and to construct linear equations.

How (Procedure of the lesson):
1. Bungee jumpers video/discussion provides a good anticipatory set.
2. Teacher jots down students' initial reactions, experiences, and comments about applications of bungee cords.
3. Have students follow the directions provided on the Data Sheet for this activity.
4. Teacher facilitates discussion on what would happen if you used different sizes of rocks, or different sized rubberbands, why the graphic points are not exactly linear, and the proportionality constant of Hooke's Law.

For Your Information (Background information for the lesson):
1. Within the limits of each rubber band, the amount of stretch of the rubberband will be directly proportional to the force. This is known as Hooke's Law.
2. A graph of the length of the rubberband versus the number of rocks will be linear, until the limits of the rubberband are reached and the rubberband breaks. The slope of this line will be the constant in Hooke's Law and the y intercept will be the length of the stretched rubberband.
3. Each type or size of rubberband will have a different constant for Hooke's Law. The points may not be exactly linear due to variation in the size of rocks.
4. Other factors that may affect the experiment are weight of the object and height of object. Also the height of a jump affects the acceleration due to gravity and length and width of elastic.
5. Some South American tribes use land diving as a rite of passage to manhood.

Rocks and Rubberbands Middle Level #2

Suggested Instructional Strategies:

1. Group discussions and cooperative groups.
2. Use other student expertise for demonstration of graphing calculators.

Additional Activities (Extensions):

1. This topic can be related to springs, elasticity, suspension systems in vehicles and furniture; earthquake-proof engineering or safety standards in cars; bungee jumping used in advertising for automobiles and soft drinks; trapeze; crane cables; and mountain climbing.
2. Your friend makes a bet that you can not make a bungee jump. You need to make a scale model of yourself using a breakable object like an egg or water balloon, jumping from the top of a door to within 5 cm of the floor. String can be used rather than rubber bands to simulate South American land divers.
3. Use a calculator to determine the line of best fit.

Possible Assessment Ideas:

1. Successful completion of the activity, focusing on the ability to extrapolate and graph. A sample performance rubric for "Rocks and Rubberbands" is included.
2. Student ability to apply knowledge to new graphing situations.
3. Peer and self evaluation.

Rocks and Rubberbands Middle Level #2

Sample Performance Rubric:

Criteria	Proficient	Basic	Needs Work
Cooperative work	Works well with group, offering suggestions and listening to suggestions of others.	Works well with group most of the time, offering occasional suggestions and listening to occasional suggestions.	Does not work well with group, offering few suggestions and not listening to suggestions of others.
Sets up a valid experiment, controlling variables	Sets up a valid experiment and controls all variables except the one tested.	Sets up a valid experiment and controls most variables.	Has difficulty setting up a valid experiment and controlling the proper variables.
Extrapolation	Accurately predicts the length of rubberbands as weights are added.	Accurately predicts the length of rubberbands as weights are added some of the time.	Can not accurately predict the length of rubberbands as weights are added.
Graphing	Able to accurately label and graph the results.	Able to accurately graph, but had trouble labeling the graph.	Had difficulty graphing and labeling the graph.

Rocks and Rubberbands Middle Level #2

Data Sheet

Names: _____ _____

_____

Identify within your group who will do the following:

Measure data _____

Record data _____

Hold rock _____

1 Describe the purpose of this activity.

2. Place the first rock in the bag and measure the length of the rubber band. Record your data in the data table. Repeat this process until you have data for the first four rocks.

3. Construct a graph which represents this relationship. Label the axis and indicate increments used.

4. Predict what you think will happen when you add rock number five, using the process of extrapolation.

5. Add rock number five and record your data. Continue to add rocks, record, and graph the data.

Data Table:

Rocks	1	2	3	4	5	6	7	8	9	10
Length										
Change in Length										

6. What patterns do you see?

_____

_____

Rocks and Rubberbands Middle Level #2

7. What happens as the number of rocks increases?

8. Why are the points not all in a straight line?

9. If you had three rocks and a smaller rock, what do you think the length might be?

10. If you had 12 rocks, what do you think the length might be? Explain you answer.

11. What do you think the length of the rubber band would be with no rocks? (Find your answer by looking at the data or the graph. Then check your answer by measuring the length of the rubber band with no rocks in the bag).

    length from graph or data _____
    measured length _____ (This number is one of two special numbers).

12. Determine the average change in length for each rock added. Show below how you found your answer.

    Answer: _____ (This is a second special number).

If You Smoke, You Croak Middle Level #3

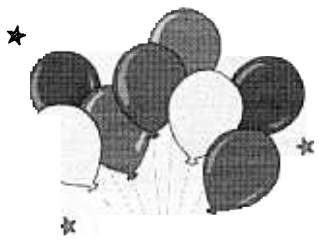
Materials\Supplies:
Balloons
Centimeter Tapes
Liter Containers
Non-smoking Posters
Respiratory System Poster

Topic Strands:
Cells and Heredity
Spatial Relationships
Data Analysis
Algebraic Topics

Conceptual Threads:
Systems and Interactions
Connections
Technology
Connections

Process Skills of Learning:

Connecting	Interpreting Data	Measuring
Modeling	Questioning	Reasoning



Why (Purpose/Objective of the lesson):

1. To relate the volume of spheres to lung capacity.
2. To discover connections between algebraic concepts of slope, linear functions, and power functions; and the geometric concepts of circle, sphere, volume, and pi.
3. To understand, interpret, and appreciate data discrepancies.
4. To investigate the effects of different variables on lung capacity.

How (Procedure of the lesson):

1. Arrange "No Smoking" posters in the room to stimulate student interest.
2. Examine animal lungs obtained at local meatpacking plant, butcher, or veterinarians.
3. Teacher records initial thoughts and comments from students about lung capacity and the effects of smoking.
4. Discuss and estimate the volume of one's lungs in liters.
5. Have students exhale normally and then force the residual volume out into a balloon. Have partners measure the circumference of the balloon and calculate its volume in cubic centimeters. Record three trials and average. Record on the classroom chart.
6. Have each student take the biggest breath and force all the air into the balloon. Measure the circumference of the balloon and calculate the volume in cubic centimeters. Record three trials and average. Record the average on the classroom chart.
7. Graph the results (diameter on x-axis and circumference of balloon on y-axis, or plot diameter of balloon on x-axis and volume on y-axis).
8. Have students calculate the mean, mode, and median for both total capacity and residual capacity.
9. Convert cubic centimeters to liters and compare to liter containers. Graph the volume versus the diameter.
10. Compare the results of smokers, to non-smokers, and asthmatics.

If You Smoke, You Croak Middle Level #3

11. Debrief by discussing factors that can cause variability in data and how the experiment could be altered to minimize these kinds of errors.
12. Collect community data on the effects of the anti-smoking campaign, e.g., no-smoking areas, designated smoking areas, non-smoking lodging.

For Your Information (Background information for the lesson):

1. Use soft, easy-to-blow balloons.
2. Smoking statistics can be obtained from the American Cancer Society.
3. Facts you will need to know:
   a. The slope of the line for diameter versus circumference graph equals pi.
   b. The graph of volume versus diameter is a curved line.
   c. Conversion from cubic centimeters to liters is to divide by 1000
4. Students with respiratory problems such as asthma must receive special consideration.
5. If you use the animal lung station, the activity should be prefaced by educating students that the lungs do not inflate by blowing air in. Due to the lack of a functioning diaphragm, lung inflation must be aided by pushing air into the lungs. Community connections to "Recussa Annie" can be made here.

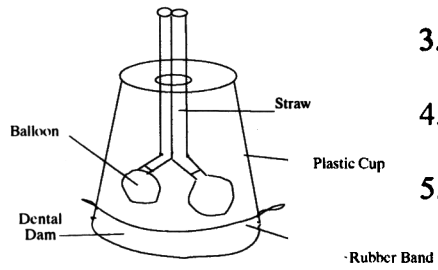
Suggested Instructional Strategies:

Use cooperative learning to investigate and solve problems. If possible, lab stations could be set up and covered by mentor upper-level students.

Additional Activities (Extensions):

1. Discuss the minutes off one's life for each cigarette smoked. This ties in well with DARE Program.
2. A model of a lung machine makes a good anticipatory set. See diagram.
3. Research diseases that could affect lung capacity, such as stroke or heart attack.
4. Circumference can be measured with balloons filled with one breath, two breaths, three breaths.
5. Measure the time it takes for air to flow out of the balloon (flight time). Graph diameter versus flight time, or volume versus flight time. This works well with a unit on respiration. For instance, the importance of residual volume in life-threatening situations and CPR could be explored.
6. Current issues such as smokers' versus nonsmokers' rights, effect of environmental pollutants on breathing, and subsidies to tobacco

MODEL LUNG



If You Smoke, You Croak Middle Level #3

farmers (including historical, economic and cultural aspects) could be debated.

7. Research effects of exercise, smoking, age, sex, and second-hand smoke on lung capacity.
8. Research tobacco and its use in cultures and ceremony.
9. Do more statistical data analysis such as standard deviation and chi square test.
10. Set up stations with pig lungs, videos with smoking, making lung machines from cups and balloons, etc.
11. Research well-known people who have died as a result of complications due to smoking.

Possible Assessment Ideas:

1. Observe involvement in group sharing of questions.
2. Examine graphs and classroom charts.
   a. Look at the graph of diameter versus circumference. The points form a straight line (note that (0,0) is a point on the line). The line serves as a guide to see if calculations were done correctly. Draw a line through the points or use best fit line on calculator. The slope of the line will be close to pi.
   b. Look at the graph of diameter versus volume. If residual volume was not used it looks like a straight line ((0,0) is a point on the curve). The curve looks like a parabola but is actually a cubic because radius is cubed.
3. Use the following checklist to measure students' understanding of lung capacity.

If You Smoke, You Croak Middle Level #3

Checklist Item	Yes	No
1. Works well with partner all of the time.		
2. Can fully explain lung capacity.		
3. Can demonstrate how to measure lung capacity.		
4. Can calculate volume of balloon with ease and 100% accuracy.		
5. Can fully explain effects of smoking or residual lung capacity.		
6. Can fully explain several ways disease affects lung capacity.		
7. Can calculate averages, means, and medians with 95% accuracy.		

Checklist Criteria

Criteria	Proficient	Basic	Needs Work
Cooperative Work	Works well with partner all of the time.	Works well with partner more than half the time.	Does not work well with partner.
Understanding Total Residual Lung Capacity	Can explain fully lung capacity and demonstrate how to measure it using the balloon.	Can give basic information on lung capacity and has some idea how to measure it using the balloon.	Has difficulty explaining and/or measuring lung capacity.
Mathematical Calculations Concerning Volume	Can complete problems for calculating volume of the balloon with ease and 100% accuracy.	Can complete problems for calculating volume of the balloon with little help and at least 75% accuracy.	Has difficulty completing problems for calculating volume of the balloon without help and/or is not at least 75% accurate in calculations.
Understanding Effects of Smoking on Residual Lung Capacity	Can fully explain the effects of smoking on residual lung capacity.	Can give very basic information about smoking and residual lung capacity.	Has difficulty explaining any effects that smoking might have on lung capacity.
Extending Learning to Things That Affect Lungs Other than Just Smoking	Can fully explain the way more than one disease affects lung capacity.	Can give basic information on the way at least one disease affects lung capacity.	Has difficulty explaining exactly how lung capacity is affected by other conditions.
Other Mathematical Calculations	Can calculate averages, means, and medians with ease and 95% accuracy.	Can calculate averages, means, and medians with little help and at least 75% accuracy.	Has difficulty calculating averages, means, and medians without aid or at 75% accuracy.

If You Smoke, You Croak Middle Level #3

Estimate the volume of each student's lungs in liters (think of a two-liter pop bottle).

Person 1 Person 2

Students will explore their lung volume. Each student will need a partner to fill in the following information.

	Record Circumference	Record Flight Time	Calculate Diameter	Calculate Volume of Lung
Residual Lung Volume				
Lung Volume				
Balloon with Two Breaths				
Balloon with Three Breaths				

Circumference is equal to diameter times pi

Volume of a sphere is 4/3 times pi times radius to the third power.

Residual Volume — Exhale normally and then force the remaining air from your lungs into the balloon. Measure the circumference of the balloon using the tape measure (or string).

Lung Volume — Take as large a breath as possible. Exhale as much air as possible into the balloon. Measure the circumference of the balloon using the tape measure.

Two Breaths Fill the balloon with two breaths of air.

Flight time is measured from when the balloon is released until the balloon runs out of air (not necessarily when the balloon hits the floor). This may be enhanced by taping a straw on the opening of the balloon.

Graphing possibilities

1. Diameter versus Time
2. Circumference versus Diameter
3. Volume versus Diameter
4. Volume versus Time

Einie, Meinie, Minie, MOW Middle Level #4

Materials\Supplies:
Popsicle sticks
String
Meter sticks
Grass plot
Nielson Rating posters

Topic Strands:
Diversity
Spatial Relationships

Conceptual Threads:
Systems and Interactions
Estimation

Process Skills of Learning:
Communicating Connecting Inferring Measuring
Observing Patterning

Why (Purpose/Objective of the lesson):
To experience random sampling by using grass plants to estimate populations and to investigate the effects of variables on population.

How (Procedure of the lesson):
1. Have student estimate the number of grass blades in an entire area and share their reasoning strategies.
2. Each group will mark off three 100 square centimeter areas of lawn using popsicle stick stakes and string.
3. Students count the blades of grass in each marked off area and record.
4. Students average the three results.
5. Students determine the area of the entire lawn and number of blades of grass using their sample. Record.
6. Students compare their estimates, strategies, and graphing results.
7. Teacher facilitates discussion that relates population samples in various environments, population discrepancies, and influencing factors.
8. Do a population sample of bugs, diseased plants, or a specified weed.

For Your Information (Background information for the lesson):
1. Before beginning the investigation, the class must decide whether to count the grass as blades or plants so data can be compared and contrasted.
2. Research can be done and guest speakers secured regarding real-world applications of random sampling; such as animal populations, seed companies, insurance companies, or food industry location sampling.
3. Astronomers use sampling for density of bodies in the universe, park rangers for animal densities, farmers for chinch bugs, and insurance adjustors for crop damage.

Einie, Meinie, Minie, MOW — Middle Level #4

Suggested Instructional Strategies:
Encourage students to experiment and investigate variables that affect population growth. Use cooperative groups and group discussions to facilitate student learning.

Additional Activities (Extensions):
1. Use different geometric shapes to determine the 100 square centimeter areas.
2. Explore variables such as light, temperature, and aeration on grass germination and growth.
3. Compare data on two similar plots, such as fertilized and unfertilized.
4. Do a census of several blocks near the school, extrapolate to city population, and compare to recent census figures.
5. Sample shaded areas and areas of high foot traffic to show the impact on the environment.
6. Determine other nature populations, such as owls.
7. Investigate biomass and biodiversity.
8. Have students write a story from the point of view of an ant.
9. Work with students on scientific notation.
10. Repeat the investigation with samples from other areas that are affected by different variables such as traffic, light, fertilizer, aeration, species of grass.
11. Discuss how adding a multilevel apartment building affects the surrounding environment (parking, neighborhood traffic, etc.)

Possible Assessment Ideas:
1. Examine student graphs of results.
2. Observation of student involvement in group sharing of strategies.
3. Successful completion of data analysis worksheet.
4. Pose one of these problems to the students and have them design strategies for solving it.
   a. Select an animal species and estimate its population in a given area.
   b. Determine how many blades of grass are on the football field.

Einie, Meinie, Minie, MOW Middle Level #4

Data Analysis
Grass Plots Follow-through

There is a finite number of grass blades on the football field. Why did the class arrive at different answers?

2. Why did the answers range so far in number from one another?

3. What would you accept as the real number of grass blades on the field and why?

4. What suggestions do you have to make this counting method more accurate?

5. There were multiple methods to solve this problem. Demonstrate at least two and put a star next to the method you feel is more efficient. Explain the reasons for your choice.

6. What are the real-world examples where this sampling method might be used to do data analysis?

7. What might be some factors that would influence the number of grass blades that would be counted in another grass plot?

8. Did you use mental math to calculate? If so, which exact calculations?

9. Did you and your partner(s) work well together? Why or why not?